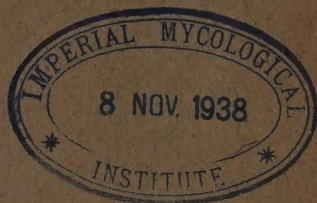


1924  
canceled  
From the Proceedings of the Linnean Society of New South Wales, Vol. xlix.,  
Part 2. 1924.



---

A CRITICAL REVISION OF THE AUSTRALIAN AND NEW ZEALAND  
SPECIES OF THE GENUS *SECOTIUM*.

By G. H. CUNNINGHAM, Government Mycologist, Department of Agriculture,  
Wellington, N.Z.

(Communicated by Professor J. B. Cleland.)

(Plates xii.-xv.; and sixteen Text-figures.)

---

[Issued 2nd July, 1924.]





# A CRITICAL REVISION OF THE AUSTRALIAN AND NEW ZEALAND SPECIES OF THE GENUS *SECOTIUM*.

By G. H. CUNNINGHAM, Government Mycologist, Department of Agriculture,  
Wellington, N.Z.

(Communicated by Professor J. B. Cleland.)

(Plates xii.-xv.; and sixteen Text-figures.)

[Read 30th April, 1924.]

There are a greater number of known species of this genus in Australia and New Zealand than anywhere else in the World, for of the 16 species discussed in this paper, 14 are confined to Australasia, and 2 occur also outside Australasia.

The following table will show the distribution of these species:—

Table of distribution of the Australasian species of *Secotium*.

Species.	Type locality.	Distribution.
<i>agaricoides</i>	Ukraine	W. Aust., N.Z. (?); America, Europe, Asia
<i>cartilagineus</i>	N.Z.	N.Z.
<i>coarctatum</i>	W. Aust.	W. Aust., S. Aust.
<i>erythrocephalum</i>	N.Z.	Tas., N.Z.
<i>Guinzii</i>	S. Africa	Tas.; S. Africa
<i>Gunnii</i>	N.Z.	Tas., N.Z.
<i>leucocephalum</i>	N.Z.	S. Aust., N.Z.
<i>melanosporum</i>	W. Aust.	W. Aust., S. Aust., N.S.W.
<i>novae-zelandiae</i>	N.Z.	N.Z.
<i>ochraceum</i>	Tas.	Tas.
<i>porphyreum</i>	N.Z.	N.Z.
<i>piriforme</i>	N.S.W.	N.S.W.
<i>Rodwayi</i>	Tas.	Tas.
<i>scabrosum</i>	Vic.	Vic.
<i>superbum</i>	N.Z.	N.Z.
<i>virescens</i>	N.Z.	N.Z.

All are saprophytes; for the most part they grow upon the ground, but certain species (e.g., *S. erythrocephalum* and *S. novae-zelandiae*) occur upon decaying wood.

Considerable confusion exists in mycological literature as to the taxonomic position of this genus; for example, De Toni (1888) placed it in the tribe Podaxineae of the family Lycoperdaceae, a classification generally followed. Fischer (1900) placed it in the Secotiaceae, a family he described to contain this and three other genera—*Cauloglossum*, *MacOwanites* and *Gyrophragmium*—although he himself has admitted it bears little resemblance to these genera, and that they bear little or no resemblance to one another. He also included the

genus *Polyplodium*, but this is a synonym of *Gyrophragmium*. Several claims have been put forward as to the position it should occupy; for example, Berkeley (1843) believed that *Secotium* and *Polyplodium* should be considered as connecting links between the Hymenomycetes and the Gasteromycetes; Fischer (1900) considered that the genus may have been an ancestral form of the Phallales, and would therefore consider it to have affinities with this family. Conard (1915), as a result of the study of the development of *S. agaricoides* (Czern.) Hollos, considered the genus to be related to *Psalliota*, as he believed it to be an arrested or paedogenic form, and would consequently place it in either the Agaricaceae or Marasmiaceae of Hennings (1897).

This genus must be retained in the Gasteromycetes for the following reasons:—

1. The development of the gleba in its first stages (until the formation of the first global cavity) agrees with that of *Psalliota* as described by Atkinson (1906, 1914, 1915), but later stages agree with the development of certain genera of the Hymenogastraceae, as, for example, *Hymenogaster*.
2. The hymenium is borne on the walls of tramal plates enclosing distinct lacunae, and not on or in structures which are wholly or in part exposed at maturity.
3. The hymenium, during the lifetime of the plant, is enclosed and the spores are set free only with the decay of the plant. Dehiscence at the base is given as one of the generic characters, but this must be interpreted in a broad sense, for although the margin of the peridium does in certain specimens separate from the base of the stipe, the spores do not become liberated, as the lacunae in this region are covered, even at maturity, by remnants of the partial veil. This structure serves as an effective cover over the exposed lacunae. Furthermore, only a minute portion of the gleba becomes exposed when this separation occurs, for the majority of the lacunae are remote from the stipe. The plants may in reality be considered to be indehiscent.
4. A distinct columella is always present and is, in part, united to the gleba during the lifetime of the plant, forming a definite and characteristic part of its structure.

In fact, were these plants devoid of columella and stipe, they would without hesitation be included in the Hymenogastraceae. On account of the nature of the basidia and spores, the structure of the gleba, and the presence of a definite stipe and columella, the genus forms a well defined group. The presence of the stipe and columella, together with the similarity of the early developmental stages, link it with the Agaricales, whereas the nature of the gleba and peridium link it with the Hymenogastraceae. It would, therefore, appear to occupy an intermediate position, and as no known genera connect it closely with either family, it should be placed in a distinct family. The family Secotiaceae of Fischer (1900a) would suffice, if emended to include those genera possessing a stipe, columella, persistent cellular gleba, tetrasporous sterigmate basidia; and to exclude any genera possessing a capillitium.

#### *Structure of the mature plant.*

*S. erythrocephalum* represents the genus as now defined fairly well; it is probably the most abundant species known, and has been well described and figured by the brothers Tulasne.

A mature plant consist of (a) peridium, (b) gleba, (c) stipe.



(a) *Peridium* (Pl. xiv., fig. 1, *p*) may be depressed-globose or ovate, and attain a diameter of 5 cm. In structure it is thick, coriaceous and in this species coloured bright scarlet. Externally it is covered with a gelatinous layer, formed of hyphae which have become gelatinised. The first few external layers of the peridium contain the colouring matter. This is in the form of fine granules, embedded in the protoplasm lining the hyphal walls. At the apex the peridium is about 3 mm. thick; it tapers to the base, where the margin is usually incurved and closely pressed to the stipe, being held in position in adult plants by the few remaining hyphae of the partial veil. Frequently the margin is lacerate, and sometimes it may be decurrent.

(b) *Gleba* (Pl. xiv., fig. 1, *gl*).—This constitutes the body of the peridium. It consists of very numerous tramal plates, which ramify through the interior, anastomosing at frequent intervals to enclose irregular lacunae. The walls enclosing the lacunae are lined with the hymenium, which consists of basidia closely compacted together in the form of a palisade layer. The tramal plate is composed of three classes of tissue: (1) an inner layer of parallel hyphae, the trama (Text-fig. 1, *tr.*), (2) a layer on either side of this composed of small irregularly polygonal cells, comprising the sub-hymenium (Text-fig. 1, *sub.*), and (3) the palisade layer of basidia (Text-fig. 1, *hym.*). When mature, each basidium bears on its distal end four slender sterigmata, to the apices of which the spores are attached. The spores are smooth, coloured and continuous. The structure of the gleba varies with the species; for example, in the species under discussion it is cellular, but in others it may be lamellar (*S. agaricoides*), or labyrinthiform (*S. porphyreum*).

(c) *Stipe* (Pl. xiv., fig. 1, *st*).—The stipe is well developed in most species, is central, and extends from the substratum to the apex of the plant, where it merges with the peridium. The portion which passes through the gleba is termed the columella (Pl. xiv., fig. 1, *col.*), the anterior half of which, during the lifetime of the plant, is united with the gleba, and is not separable from it. The lower portion of the columella is surrounded by a conical cavity which extends from the base of the peridium to about half-way into the gleba. The portion of the columella which merges with the gleba is solid, but the portion below this, together with the stipe, is in this species always hollow. In two species the stipe is solid throughout, whilst in others the cavity may be filled with loosely woven hyphae. Frequently the apex of the columella is thickened somewhat, especially in those species which are umbilicate. The stipe is attached to the substratum by coarse, coloured or white rhizoids; in certain species, as the one under discussion, these may extend for several centimetres from the point of attachment, and it is from these rhizoids that the various developmental stages may be obtained.

Dehiscence is supposed to be effected by the separation of the base of the peridium from the stipe. Although this separation often occurs, it does not result in the liberation of the spores, since most are enclosed within cavities remote from the base of the peridium and those cavities adjacent to or adjoining the base of the peridium are not always exposed, being commonly covered by the remains of the partial veil (Pl. xv., fig. 2). Therefore, as the plants are dependent on decay for the release of the spores, they are in reality indehiscent.

Decay of the plants, in New Zealand at any rate, is readily and rapidly effected by the larvae of an insect which, in the course of a few days, convert the whole of the gleba into a viscid mass. In fact, so rapid is the destruction wrought by these larvae, that they will completely destroy a collection within 48

hours. It is probable that they serve in some measure to disseminate the spores. Slugs, too, probably are instrumental in the dissemination of the spores, for many plants, especially of *S. novae-zelandiae*, are frequently found to be much damaged by these animals.

#### *Development and Cytology.*

The writer has recently carried out an investigation into the development of *S. erythrocephalum* and *S. novae-zelandiae*, the detailed results of which will be published elsewhere. An abbreviated description of the developmental stages of the latter species will be given here since it embraces a more complete series and since the development of the two species differs only in minor details.

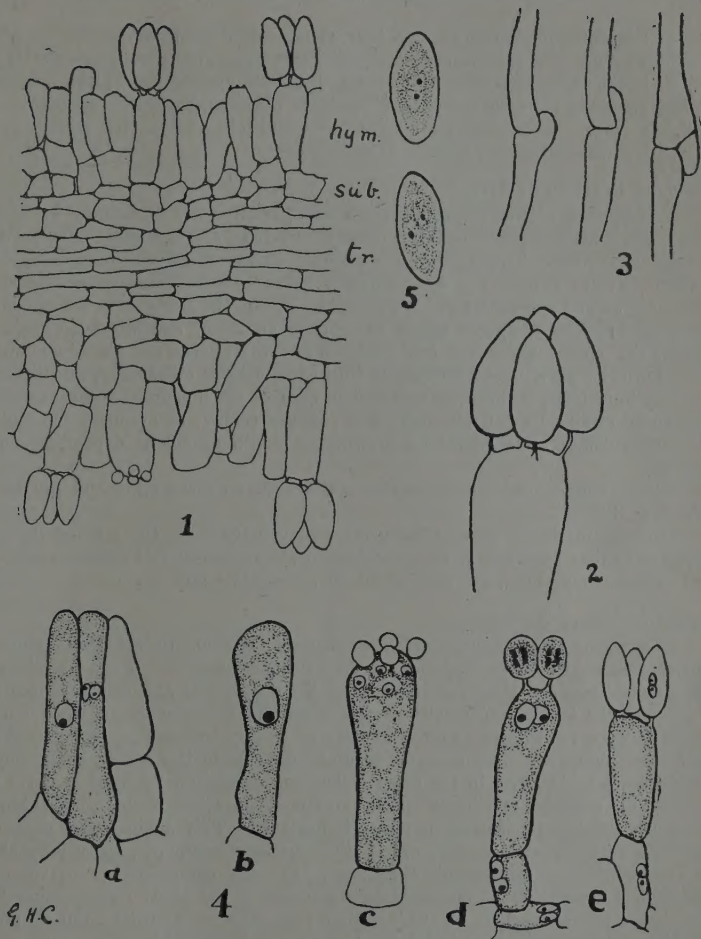
Numerous specimens in all stages of development were obtained from rhizoids springing from mature plants. These were fixed in picro-formol, sectioned, and stained in iron-alum haematoxylin, followed by 1% iodine green in clove oil.

Young plants are first noticeable as small white swellings on the rhizoids. Sections show these swellings to consist of intricately woven, undifferentiated hyphae. They continue to grow slowly until they are about 2 x 1 mm., when sections show that differentiation has commenced. The stipe is the first to become differentiated, and is at this stage recognisable on account of the parallel arrangement of its component hyphae. In the undifferentiated apical region (the primordium of the peridium and gleba) appears a small compact area of deeply staining hyphae. In this area a small radial cavity appears (Pl. xii., fig. 1), followed by differentiation of the lower portion of the columella. In the glebal cavity a palisade of closely compacted hyphae appears, and simultaneously, extending downwards from the floor of the cavity to the upper and outer margin of the stipe, appears a wedge-shaped radial area (Pl. xii., fig. 2), noticeable on account of the hyphae of which it is composed being less closely compacted. This is the partial veil. No further growth occurs in this region, so that as the stipe and columella increase in size, the hyphae composing the partial veil become more and more drawn apart, until at maturity a few only persist, holding the base of the peridium in contact with the stipe. Fragments of the veil persist on the periphery of the stipe, giving to it a somewhat fibrillose appearance.

Following the appearance of the first glebal cavity, the stipe makes little growth until the plant is about one-quarter the normal size. Then it commences to thicken, and after a time to elongate. The cavity of the stipe appears shortly after the first glebal cavity (Pl. xii., fig. 3). The columella gradually grows, becoming slowly differentiated from the primordial tissues of the gleba until the plant is about one-quarter grown, when it merges with the peridium, which is not differentiated until about this time.

The palisade layer of the glebal cavity extends around the walls of the cavity until it almost surrounds it; then outgrowths grow downward from the roof and merge with the side walls, dividing the original cavity into several smaller ones (Pl. xii., figs. 3-4). At the same time small lacunae begin to appear in the undifferentiated portion of the gleba above the original cavity (Pl. xii., fig. 4). These become lined with the hymenium and spores begin to appear on the first formed palisade (Pl. xii., fig. 2). Further differentiation of the gleba consists in the continuous appearance of these lacunae (Pl. xii., fig. 5; Pl. xiii., fig. 1), until the whole of the area enclosed within the peridium is perforated with them. These lacunae also appear in the tramal plates, which become thinner in consequence. Colour now appears in the exterior cells of the peridium, it enlarges rapidly, and at the same time is carried upwards by the





Text-fig. 1. Section through the tramal plate of *S. erythrocephalum* Tul. *hym.*, hymenium; *sub.*, subhymenium; *tr.*, trama. (x 1000).

Text-fig. 2. Basidia of *S. novae-zelandiae* G. H. Cunn. (x 1500).

Text-fig. 3. Clamp connections from partial veil of *S. novae-zelandiae* G. H. Cunn. (x 1000).

Text-fig. 4. Nuclear phenomena of *S. erythrocephalum* Tul. (x 1000). *a.* Nucleus of basidium before (left) and after division (right) preceding nuclear fusion; *b.* fusion nucleus; *c.* 4 nuclei in distal end of basidium prior to migration into spores; *d.* 2-spored basidium from which 2 nuclei have migrated; they are shown in the spores, in mitosis; *e.* nearly mature spores showing binucleate condition.

Text-fig. 5. Two binucleate spores of *S. erythrocephalum* Tul. (x 1000).

rapid elongation of the stipe. So that at maturity, the plant stands well above the substratum, and the gleba consists of plates surrounding very minute lacunae.

It is thus seen that the early stages, until the appearance of the first glebal cavity, resemble the development of *Psalliota* (= *Agaricus*), but from this stage onwards further differentiation of the gleba is similar to that of certain genera of the Hymenogastraceae, notably *Hymenogaster*.

#### *Cytology* (Text-figs. 2-5).

The hyphae of the columella, stipe and peridium are invariably bi-nucleate. The basidia at first are binucleate, these nuclei fuse, and a slightly larger fusion-nucleus is formed. This takes up a position in the distal end of the basidium; there it divides twice. The first division precedes the formation of the sterigmata, the second succeeds their appearance. When the sterigmata are about half their normal length, spores begin to appear on them, and when they are full length, the spores are about half size. When the spores are about one-quarter their normal size, a nucleus migrates into each, divides mitotically, and the spore becomes binucleate, a character constant in each of the numerous species examined. The spore attains its full size before it changes colour; at maturity the epispore becomes coloured some shade of brown, the depth of colour depending on the species.

Clamp connections are abundant in the tissues of the stipe and partial veil (Text-fig. 3).

On germination a germ tube protrudes, usually from the end of the spore opposite to that by which it was attached to the sterigma; this branches repeatedly to form a mycelium, the cells of which are septate and binucleate.

#### *Determination of Species.*

Species of this genus have proved most difficult to determine since the earlier writers, who based species on the external characters of the peridium and stipe alone, confined their descriptions to the shape, size and colour of the peridium, and the length and colour of the stipe. This was sufficient when but two or three were known, but, as the number of species increased, it became obvious that these characters were often of insufficient value in themselves, since they are decidedly variable, even in the same collection. Certain later workers have gone to the other extreme, and based species on spore characters alone, other characters being presumably considered of minor importance. This again makes determination difficult as several species, widely different in macroscopic, agree very closely or are identical in microscopic characters. For the determination of species in the field, a knowledge of macroscopic characters is essential; on the other hand, the shape, size and colour of the peridium and stipe are of little value to anyone working with herbarium material, for these characters may become wholly altered in drying. Therefore, with herbarium material, a knowledge of those characters which are not changed during drying is essential; and, as the spores and gleba undergo little alteration, their structure, colour, and other characters are invaluable aids to the systematist. Unfortunately the artificial keys in taxonomic papers are generally based on a combination of macroscopic and microscopic characters and consequently are valueless for use either in the field or in the herbarium. The difficulty of preparing an artificial key becomes apparent when the factors upon which species are based are considered, for rarely is a species described on any one character alone, but usually on the sum of two or three minor characters.



It is not claimed that the following key will enable anyone to determine a species with certitude; but it is used in this paper mainly for the purpose of dividing the genus into groups, for in a key of this nature all closely related species are brought together, when their characteristics become more apparent.

*Acknowledgments.*

The writer wishes to thank the following:—Professor J. B. Cleland, Adelaide, Mr. L. Rodway, Government Botanist, Hobart, and Mr. E. Cheel, Botanic Gardens, Sydney, for the loan of specimens in their possession; Professor Cleland, Mr. Rodway, Dr. J. R. Weir, Bureau of Plant Industry, Washington, and Messrs. J. C. Neill, E. H. Atkinson, J. G. Myers, for donations of specimens; and especially Mr. Neill for the preparation of all microscopic material used in this work.

All the descriptions given below are original, unless otherwise stated, and have been drawn up from material examined by the writer. It is believed that all species of this genus known to occur in Australasia have been examined.

SECOTIUM Kunze.

Flora, xxxiii., 1840, p. 321.—*Endoptychum* Czern., Bull. Soc. Imp. Nat. Moscou, xviii., 1845, p. 146.

Peridium stipitate, variously shaped, consisting of a single thick layer often externally brightly coloured; margin at first entire, appressed to the stipe, becoming somewhat lacerate, and in some species separate from the stipe.

Stipe central, long or almost obsolete, inserted in a depression in the base of the peridium, hollow, stuffed or solid; continuing as a columella to the apex of the peridium.

Gleba cellular, labyrinthiform or lamellar, permanent, indehiscent, consisting of numerous anastomosing plates enclosing irregular lacunae; hymenium lining free surfaces of plates; cystidia or other aberrant cells absent. Basidia commonly tetrasporous, spores borne on slender sterigmata, variously shaped, continuous, hyaline or coloured, rough or smooth, binucleate.

*Habitat.*—Saprophytic upon decaying humus in the ground, or upon rotting wood buried in the substratum; commonly in shady and damp places.

*Distribution.*—North and South America, Africa, Europe (excluding Britain), Asia, Australia and New Zealand.

About 22 species have been recorded, 11 of which have been collected in Australia and New Zealand. Sixteen species (including 5 described as new) are discussed in this paper, all but 2 of them being confined to Australasia.

Species of the genus are characterised by the structure and permanent nature of the peridium, and the presence of a definite stipe and columella. The peridium consists of a single coriaceous cortex. The gleba is cellular, and consists of tramal plates anastomosing at various points, enclosing irregular cavities or lacunae, the inner walls of which are lined with the hymenium. The stipe is usually well defined and traverses the gleba as a columella. Plants are commonly epigeal, but one or two species are known which are at first subterranean, and approach the surface only when they near maturity; a New Zealand example is *S. porphyreum*. One Tasmanian species, *S. Rodwayi*, is said to be truly hypogaeal and is exposed only (?) by burrowing marsupials. Another peculiarity worthy of note is that whereas most of the New Zealand species are brightly coloured, the Australian species, with the exception of *S. piriforme*, are some shade of grey or brown.

Fischer (1900) has included the genus *Elasmomyces* Cav. as a synonym of *Secotium*, but the presence of cystidia in the hymenium would serve as a character sufficiently important to warrant its separation, for of the 15 Australasian species examined by the writer, not one possesses cystidia.

*Artificial Key to the Species.*

Spores smooth.

Peridium smooth, usually viscid.

Gleba ochraceous or ferruginous.

Peridium some shade of blue or green.

Stipe long, 3 cm. or more . . . . . 1. *S. superbum*.

Stipe short, 2 cm. or less . . . . . 2. *S. virescens*.

Peridium scarlet . . . . . 3. *S. erythrocephalum*.

Gleba chocolate or sepia-coloured . . . . . 4. *S. novae-zelandiae*.

Peridium rough; scabrid, hispid or tomentose.

Gleba tan, ochraceous or ferruginous.

Spores over  $10\mu$  . . . . . 5. *S. ochraceum*.

Spores under  $10\mu$  . . . . . 6. *S. coarctatum*.

Gleba bronze or almost black.

Stipe long, 3 cm. or more . . . . . 7. *S. melanosporum*.

Stipe short, 2 cm. or less . . . . . 8. *S. agaricoides*.

Spores rough.

Peridium smooth, usually viscid.

Stipe solid.

Stipe long, 3 cm. or more . . . . . 9. *S. leucocephalum*.

Stipe short, 2 cm. or less . . . . . 10. *S. Gunnii*.

Stipe hollow.

Stipe long, 3 cm. or more.

Spores over  $10\mu$  . . . . . 11. *S. porphyreum*.

Spores under  $10\mu$  . . . . . 12. *S. Guinzii*.

Stipe short, 2 cm. or less . . . . . 13. *S. piriforme*.

Peridium rough; scabrid, hispid or tomentose.

Gleba cellular.

Spores over  $10\mu$  . . . . . 14. *S. cartilagineus*.

Spores under  $10\mu$  . . . . . 15. *S. Rodwayi*.

Gleba lamellar . . . . . 16. *S. scabrosum*.

All drawings and photographs are original; the drawings of spores have been made with the aid of a camera lucida, and are all  $\times 1,000$  diameters. I have not presented photographs of dried plants, as they are worthless for illustrative purposes.

1. SECOTIUM SUPERBUM, n.sp. (Pl. xiv., fig. 2; Text-fig. 6a.)

Peridio caeruleo, griseo-viride vel viride, conico, apice acuto, ad 8 cm. alto, 4 cm. lato, primum pruinoso demum glabro, leve. Stipite aurantio, ad 5 cm. longo, 12 mm. crasso, leve, glabro, excavato. Gleba brunnea, cellulosa. Sporibus levibus, pallido-brunneis, ovatis vel ellipticis,  $14-18 \times 6-8\mu$ .

Hab.: Solitarii ad terram in locis gramineis.

Otaki Forks, Upper Otaki River, Wellington, N.Z. 300 m. J. G. Myers, E. H. Atkinson.

Peridium azure, sage-green or sea-green, sometimes mottled with pallid spots, conical, apex sharply acuminate, base strongly excavated, truncate, or more frequently margin decurrent, up to 8 cm. high, and 4 cm. wide, at first pruinose, becoming glabrous, polished and slightly viscid; drying dull green or olivaceous.



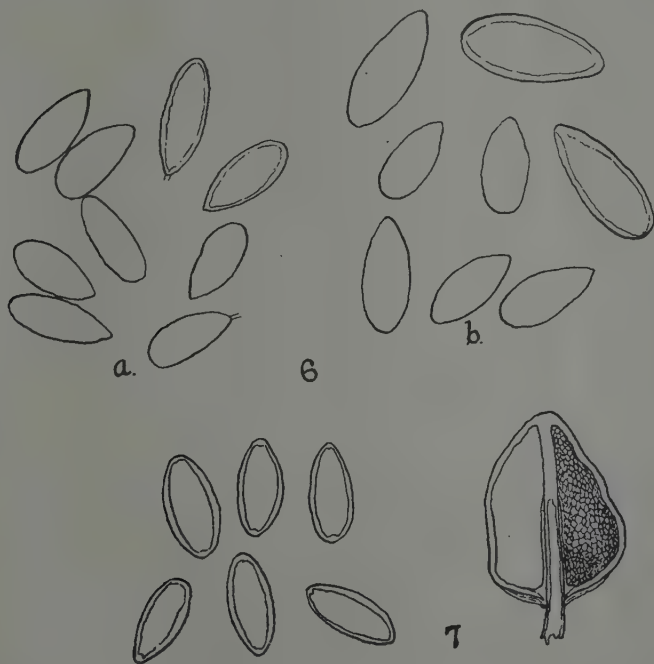
Stipe bright yellow, stout, up to 5 cm. long, and 12 mm. wide, tapering from base to apex, smooth, shining, hollow; columella slightly thickened at the apex.

Gleba ferruginous, cellular, cells 2-4 mm. long, laterally compressed, dissepiments thin.

Spores smooth, pallid ferruginous, ovate or elliptical, one end rounded, the other pointed, frequently shortly pedicellate,  $14-18 \times 6-8 \mu$ , epispore thin.

*Habitat*.—Solitary on the ground in grassy places in the forest.

*Distribution*.—Otaki Forks, Upper Otaki River, Wellington, N.Z. (300 m., J. G. Myers, E. H. Atkinson, 8/7/22. Type), Forest Reserve, Whakatikei, Packakaviki, Wellington, N.Z. (45 m., J. G. Myers, J. C. Neill, 16/6/23). Collections in the herbarium of the writer, Nos. 922, 1094.



Text-fig. 6. a. Spores of *S. superbum*. ( $\times 1000$ ). b. Spores of *S. erythrocephalum* Tul. ( $\times 1000$ ).

Text-fig. 7. *S. virescens* Mass. Plant (nat. size); spores ( $\times 1000$ ).

The large conical peridium, stout yellow stipe and large smooth spores characterise this species. It closely resembles the following species, but is separated on account of the shape and large size of the peridium. It is a magnificent species, the azure peridium and yellow stipe being very conspicuous. The base of the peridium does not as a rule separate from the stipe, but remains

closely pressed to it. This is one of the largest species known, and should be readily determined on this account.

## 2. SECOTIUM VIRESCENS Massee. (Text-fig. 7.)

Mass., Grevillea, xix., 1890, p. 47; Sacc., Syll. Fung., ix., 1891, p. 266.

Peridium pallid sage-green, ovate or broadly conical, apex obtusely acuminate, base abruptly rounded, slightly or not excavated, 2.3 cm. high, 2.25 cm. broad, coriaceous, glabrous, shining, with occasional longitudinal furrows, margin lacerate, somewhat decurrent; drying dull green.

Stipe greyish-white, short (almost obsolete in the specimen examined), about 5 mm. long, hollow, smooth, glabrous, tapering from base to apex; columella slightly expanded at the apex.

Gleba ferruginous, cellular, cells regular, laterally compressed, 2.3 mm. long, dissepiments thin, enclosed within a dense purplish-brown layer within the wall of the peridium.

Spores smooth, pallid ferruginous, elliptical, ends bluntly pointed, 15-18  $\mu$  7-8  $\mu$  (Massee 18-20  $\times$  7-8  $\mu$ ; Cleland 14.5-16  $\times$  8  $\mu$ ), epispore thin.

*Habitat*.—Solitary on the ground in rain forest.

*Distribution*.—Dannevirke, N.Z. (W. Colenso. Type, in Herb. Kew). Locality unknown (T. Kirk. Specimen in Herb. Kew), Bluff, Southland, N.Z. (J. B. Cleland, 10/6/22. Specimen in Herb. Cleland).

This species is characterised by the colour of the peridium and gleba, short, almost obsolete stipe and the large size of the spores. The plant somewhat resembles the preceding.

I am indebted to Dr. Cleland for the loan of the specimen from which the above description has been drawn up. In a note accompanying the specimen he has given details as to the colour, shape and size of the peridium when collected, and these have been incorporated in the above description.

This species was originally described from material forwarded to Kew by Colenso. It is apparently rare, for, with the exception of one collection made by the late Mr. T. Kirk, Dr. Cleland's plant is the only collection made since the species was described.

## 3. SECOTIUM ERYTHROCEPHALUM Tulasne. (Pl. xiii., fig. 2; Text-fig. 6b.)

Ann. Sci. Nat., ser. 1, vol. 3, 1844, p. 115.—Sacc., Syll. Fung., vii., 1888, p. 54; xi., 1895, 158; Mass., Grev., xix., 1890, p. 96; Cke., Hdbk. Aus. Fung., 1892, p. 221; Lloyd, Lye. Aus., 1905, p. 6, t. xxvi., f. 1-6.

Peridium scarlet, globose, depressed-globose or ovate, apex obtuse or rounded, base excavated, truncate or decurrent, 2.4 cm. high, up to 6 cm. wide, smooth, frequently somewhat lobed, glabrous, shining, often slightly viscid; retaining its colour when dried.

Stipe bright yellow, slender, up to 10 cm. long, 3-10 mm. thick, equal, smooth or fibrillose, often polished, hollow; columella slightly expanded at the apex.

Gleba ferruginous, cellular, cells polygonal or slightly elongate, up to 3 mm. long, numerous, dissepiments thin.

Spores smooth, pallid ferruginous, elliptical or elliptic-ovate, bluntly pointed at one or both ends, 12.25  $\times$  7-11  $\mu$ , (Tulasne, 12  $\times$  5  $\mu$ ; Massee 10-11  $\times$  5  $\mu$ ; Lloyd, about 12  $\times$  6  $\mu$ ).

*Habitat*.—Gregarious or solitary on decaying wood on the forest floor.



*Distribution*.—Tasmania; N.Z. (Herb. Nos. 120, 610, 938, 1097). Common throughout the lowland forests of New Zealand.

I have collected this species at Auckland, Hamilton, Cambridge, Rotorua, Te Aroha (Auckland Province); Weraroa, Mt. Waiopelu, York Bay and Botanical Gardens (Wellington Province); and have received collections from Peel Forest (from Dr. H. H. Allan), and Governors Bay (from Mr. J. F. Tapley), Canterbury Province; and Dun Mt., Nelson Province (from Mr. J. C. Neill). It is not confined to the forest, for several collections have been obtained from flower gardens, especially where these have been at one time in forest. It is commonly stated that this species grows on the ground; but although I have collected hundreds of these plants, I have always found them to be attached to decaying wood.

The scarlet colour of the peridium separates this from any other species, but in glebal and spore characters it is closely allied to *S. virescens* and *S. superbum*.

The spore measurements I have given are much greater than those given by other writers. But with certain large forms found here, spores of a length of  $25\ \mu$  are not uncommon. I believe that it would be inadvisable to separate these forms, for they are identical in all other respects. Furthermore, intermediate stages, in which the spores vary in size between the large and small spore forms, are not uncommon.

This species was named by Tulasne from material collected at Akaroa, Banks Peninsula, Canterbury, by Raoul, now preserved in the museum herbarium at Paris.

#### 4. SECOTIUM NOVAE-ZELANDIAE, n.sp. (Pl. xiii., fig. 3; Text-fig. 8a.)

Peridio pallido-griseo vel pallido-viride, ovato vel elliptico-oblongo, apice acuto vel obtuso, 3-5 cm. alto, 1.5-3 cm. lato, primum fibrilloso demum leve, glabro. Stipite pallido-griseo vel pallido-viride, 4 cm. longo, 6 mm. crasso, glabro, excavato. Gleba brunneo-nigra, cellulosa vel lamelliforma. Sporis brunneo-nigris, elliptico-ovatis, vel ellipticis, levibus,  $11-15 \times 5-8\ \mu$ .

Hab.: Solitarii vel gregarii ad lignis in silvis.

Weraroa, Wellington, N.Z. 100 m. G.H.C.

Peridium commonly french-grey, changing in old specimens to pallid-green, ovate or elliptic-oblong, apex bluntly acuminate or obtuse, base bluntly rounded, or decurrent, 3-5 cm. high, 1.5-3 cm. wide, at first finely fibrillose, fibrils longitudinally arranged, so that the surface appears striate, becoming smooth, glabrous, polished and slightly viscid, coriaceous; margin folded and frequently lacerate, drying dingy brown.

Stipe pallid french-grey or tinted bluish-green, yellowish at the base, slender, up to 4 cm. long, and 6 mm. thick, equal, at first fibrillose, becoming glabrous and polished, save at the base, hollow; columella thickened at the apex.

Gleba chocolate- or sepia-brown, coarsely cellular, sometimes lamellar, cells elongated, up to 10 mm., sparse, laterally compressed, dissepiments thin.

Spores smooth, sepia-coloured, elliptic-ovate or elliptical, rounded at one end,  $11-15 \times 5-8\ \mu$ , epispore thin.

*Habitat*.—Solitary or crowded on decaying wood buried in the substratum. In lowland rain forest.

*Distribution*.—Weraroa, Wellington, N.Z. (100 m., G.H.C. 1/8/19. Type), Weraroa (E. H. Atkinson, 20/8/19; J. C. Neill, G.H.C., 2/5/23), Forest, Bo-

tanical Gardens, Wellington (80 m., G.H.C., May, Aug., 1922). Specimens in the herbarium of the writer, Nos. 872, 874, 1098.

The sepia colour of the gleba serves to separate this from any other species in this section. It is fairly abundant in the early winter and spring months in lowland mixed rain-forest near Wellington. It occurs only on decaying wood, principally on rotting branches of *Melicytus ramiflorus* Forst. I have recently obtained a very complete suite of developmental stages, from which the abbreviated account of its development has been drawn up. The plant is usually covered with dried leaves, and so difficult to find unless these be first removed. It is readily eaten by slugs, and it is in consequence often difficult to find mature specimens that have not been injured by these animals.

The shape of the peridium varies considerably in different specimens, for one may obtain ovate, elliptical or even depressed-globose plants. When the plant is ovate, the columella is usually considerably thickened at the apex. Another variable feature is the gleba, which may in certain specimens be cellular, whilst in others it may be lamellar, approaching in extreme cases the gleba of *S. agarioides*. As all intermediate stages may be collected it is impossible to segregate these forms, save at the extremes.

#### 5. SECOTIUM OCHRACEUM Rodway. (Text-fig. 8b.)

Proc. Roy. Soc. Tas., 1919 (1920), p. 112.

Peridium pale ochre-brown, subglobose, base slightly excavated, 1-2 cm. diam., tomentose, very thin, hardly apparent; drying dingy brown, becoming rugulose.

Stipe short, 3-5 mm. long, 2 mm. thick, pallid brown, equal, tomentose, hollow; columella not expanded at the apex.

Gleba ochraceous, labyrinthiform, cells minute, 1-2 mm. long, dissepiments thick.

Spores smooth, pallid ferruginous, elliptical, bluntly pointed at both ends,  $12.17 \times 6.9 \mu$  (Rodway  $16 \times 8 \mu$ ).

*Habitat*.—Subterranean, solitary.

*Distribution*.—Cascades, Hobart (L. Rodway. Type). Specimens in Herb. Rodway, No. 933.

The ochraceous gleba with its labyrinthiform lacunae, and the large elliptical spores, characterise the species. The subterranean habit is a character worthy of note.

I am indebted to Mr. Rodway for the loan of his type specimens from which the above description has been drawn up.

#### 6. SECOTIUM COARCTATUM Berkeley. (Text-fig. 9.)

Berk., Hook. Jour. Bot., iv., 1845, p. 63, t.i., f. 3.—Cda., Icon. Fung., vol. 6, 1854, t. vi., f. 25-30; Sacc., Syll. Fung., vii., 1888, p. 150; Cke., Hdbk. Aust. Fung., 1892, p. 220; Lloyd, Lyc. Aus., 1905, p. 7; Cleland, Trs. Roy. Soc. S. Aust., xlvii., 1923, p. 74.

Peridium pallid greyish-brown, obovate or depressed-globose, umbilicate, base strongly excavated and truncate, up to 12 mm. high, 12-20 mm. wide, rugulose, minutely and densely tomentose, coriaceous, thick; pallid brown and rugulose when dried.

Stipe greyish, up to 2 cm. high, usually shorter, 2-3 mm. thick, glabrous or tomentose, tapering from base to apex, hollow or stuffed; columella thickened at the apex.

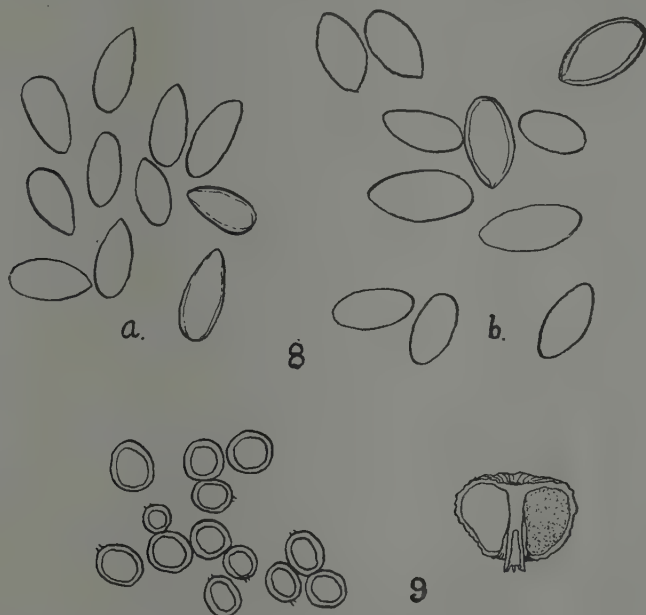


Gleba pallid grey or tinted tan colour, labyrinthiform, cells very minute, up to 0.5 mm. long, very numerous, dissepiments very thin, whole gleba crumbling readily when cut.

Spores smooth, tinted yellow, almost hyaline, subglobose to ovate, shortly pedicellate, 5-8  $\mu$  diam. (Berkeley, 5-7  $\mu$ ; Cleland, 5-7  $\mu$ ; Lloyd, 6 x 5  $\mu$ ), epispore thick.

*Habitat*.—Solitary on the ground.

*Distribution*.—Swan River, W. Aust. (Drummond. Type, in Kew Herb.), Narrabri, N.S.W. (J. B. Cleland, 2/6/19), Adelaide, S. Aust. (Miss Joan Cleland, 20/5/23). Material in Herb. Cleland.



Text-fig. 8. a. Spores of *S. novae-zelandiae*. (x 1000); b. Spores of *S. ochraceum* Rodw. (x 1000).

Text-fig. 9. *S. coarctatum* Berk. Plant (nat. size); spores (x 1000).

Characterised by the pallid colour and minute cells of the gleba, pallid colour and tomentose surface of the peridium, and small, smooth, subhyaline spores.

I am indebted to Dr. Cleland for the loan of the material from which the above description has been drawn up. In a note accompanying the specimens he stated that the plant possesses a strong and pleasant odour, especially noticeable when freshly collected. This odour apparently disappears from old material, however, for I have been unable to detect it in the material at hand.

The peculiar nature of the gleba is worthy of note, for this structure is present in no other species. Apart from its light colour and minute cells, it is

extremely friable, crumbling so readily before the razor as to make it a difficult matter to obtain a section.

Lloyd (1905) believes *S. Gunnii* to be a synonym, but this is not the case, for the global characters are quite different; the rough spores of *S. Gunnii* alone are sufficient to separate it.

#### 7. SECOTIUM MELANOSPORUM Berkeley. (Pl. xv., fig. 1; Text-fig. 14a.)

Berk., Hook. Jour. Bot., iv., 1845, p. 62, t. i., f. 2.—Cda., Icon. Fung., vol. 6, 1854, t. vi., f. 19-24; Sacc., Syll. Fung., vii., 1888, p. 54; Cke., Hdbk. Aust. Fung., 1892, p. 220; Lloyd, Lye. Aust., 1905, p. 7, t. xxvi., f. 9-12; Myc. Notes, 1922, p. 1116, f. 2111; Cleland, Trs. Roy. Soc. S. Aust., xlvii., 1923, p. 73.

Peridium dingy-grey, darker above, strongly depressed-globose, deeply umbilicate, base deeply excavated, truncate, 3-4 cm. high, up to 3 cm. wide, finely scabrid and longitudinally striate; dingy-grey and minutely rugulose when dried.

Stipe dingy-grey, up to 4 cm. long, 8-12 mm. thick, stout, woody, equal, scabrid, central portion coarsely cellular; columella strongly thickened at the apex.

Gleba dark sepia-brown, almost black, cellular, cells minute, up to 0.5 mm. long, laterally compressed, dissepiments thin, whole context tough and resistant.

Spores smooth, sepia-coloured, ovate or less commonly elliptical, bluntly pointed at one end, rounded at the other, variable in size, 5-11 x 4-6  $\mu$  (Berkeley, 6-10 x 4-7  $\mu$ ; Cleland, 8-9.5 x 6.5-7.5  $\mu$ ), epispore thin.

*Habitat*.—Solitary on the ground.

*Distribution*.—Swan River, W. Aust. (Drummond. Type, in Herb. Kew), Monart South, S.A. (J. B. Cleland, 27/5/21. Specimen in Herb. Cleland), Broken Hill, N.S.W. (A. Morris, Herb. Botanic Gardens, Sydney).

Characterised by the dark coloured spores, firm nature, almost black colour and very minute cells of the gleba. The peculiar woody stipe is also worthy of note. In the description given by Berkeley it is stated to be solid, but in the specimens I have examined there is a distinct central portion, extending from the base of the peridium to the base of the stipe, which is coarsely cellular. The cells of the gleba are extremely small and closely compacted together, and in certain parts numerous hyaline hyphae traverse them, giving the gleba a peculiar appearance under the low power.

The plant was first found by Drummond in 1844 in Western Australia on the bank of the Swan River. Until Dr. Cleland's specimens were obtained in 1921 no other collection had been made. I am indebted to Dr. Cleland for the loan of his specimens and for his donation of a specimen which is now in my herbarium, No. 1202. Also to Mr. Edwin Cheel for the loan of the specimen in his possession.

#### 8. SECOTIUM AGARICOIDES (Czernaïen) Hollos. (Text-fig. 10.)

Hollos, Gasteromycetes Hungariae, 1903.—*Endoptychum agaricoides* Czern., Bull. Soc. Imp. Nat. Moscou, xviii., 1845, p. 146, t. ii.-iv.—*Secotium acuminatum* Mont., Fl. Alg., vol. 1, 1845, p. 371, t. xxii. bis, f. 4.—*S. Thunii* Schulz, Verh. zool.-bot. Ges. Wien, vol. 15, 1865, p. 792.—*S. Szabolcsense* Haz. linsky, Mathem. et termes Zettudom Koslemenyek. vol. 13, 1875, p. 11.—*S. Warnei* Peck, Bull. Torr. Club, vol. 9, 1882, p. 2.—*S. pedunculatum* Lloyd, Myc. Notes, 1918, p. 788, f. 1183.

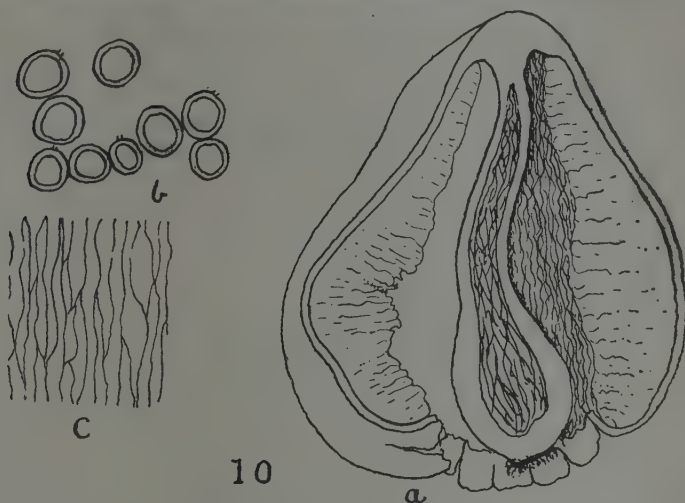
Sacc., Syll. Fung., vol. 7, 1888, p. 53; Cke., Hdbk. Ans. Fung., 1892, p.

220; Lloyd, Myc. Notes, 1903, p. 138, t. xiii., f. 1-11; 1916, f. 874; Conard, Mycologia, vol. 7, 1915, p. 104, t. clvii., f. 1-6.

Peridium dingy-grey, ovate, obtusely conical or subglobose, apex obtuse, base abruptly rounded or truncate, excavated, up to 8 cm. high and 5 cm. broad, minutely scabrid, and finely longitudinally striate, margin lacerate, often lobed.

Stipe very short, almost obsolete, dingy grey, scabrid, stuffed, up to 2 cm. long and 18 mm. wide at the base, where it is sometimes much inflated; columella thickened at the apex, free throughout.

Gleba dark bronze-brown, lamellate, lamellae sinuate, margins finely serrate, sparsely anastomosing, vertically arranged around the inner wall of the peridium.



Text-fig. 10. *S. agaricoides* (Czern.) Hollos. *a*. Plant (nat. size); *b*. spores ( $\times 1000$ ); *c*. lamellar gleba ( $\times 2$ ).

Spores smooth, ferruginous, globose or subglobose,  $5-8\mu$  diam., sometimes shortly pedicellate; epispore thick.

*Habitat*.—Solitary on the ground in open grassy areas.

*Distribution*.—North America, Eastern Europe, Hungary, Russia, North Africa, Western Australia, New Zealand.

Western Australia: F. W. Stoward (*cf.* Lloyd, Myc. Notes, 1916, p. 617).

The illustrations and description are based on American specimens kindly donated by Dr. J. R. Weir, now in my herbarium, No. 1201.

The globose spores, bronze coloured, lamellate gleba and short, stout stipe characterise this species. It is an aberrant species, for the characters of the gleba and stipe are not typical of the genus as it is now understood.

The plant was first described in 1845 as *Endoptychum agaricoides* by Czernajen, from a plant collected in Ukraine; later, Montagne obtained a specimen from Algiers, which he named *S. acuminatum* (under which it is generally known); then in North America Peck obtained specimens which he named *Lycoperdon*



Warnei; later he changed the name to *Secotium Warnei*. *S. pedunculatum* was a name applied by Lloyd to a pedunculate form. I doubt whether such a minor character is sufficient to separate a species, especially in such a variable plant as this.

It has been recorded by Hollos from Australia (Banks Peninsula) [*sic*] and New Zealand; as I have not seen his paper I am unable to state where the plant was supposed to have been collected, or by whom.

#### 9. SECOTIUM LEUCOCEPHALUM Massee. (Text-fig. 11.)

Mass., Grevillea, vol. 19, 1890, p. 95; Sacc., Syll. Fung., vol. 11, 1895, p. 157.

Peridium dingy-grey, depressed-globose, somewhat umbilicate, base truncate, excavated, 9-12 mm. high, 20-26 mm. wide, smooth, minutely longitudinally striate, glabrous, margin tardily separating from the stipe; drying pallid brown, surface becoming rugulose.

Stipe whitish, slender, 12-25 mm. long, 3-4 mm. thick, attenuate downwards, solid, striate, smooth, polished; columella expanded at the apex.

Gleba ferruginous, cellular, cells laterally compressed, up to 3 mm. long, dissepiments thin.

Spores verruculose, pallid ferruginous, ovate or ovate-elliptical, commonly lachrymiform, rounded at one end, pointed at the other,  $9-11 \times 5-7 \mu$  (Massee,  $8 \times 5 \mu$ ), epispore thin.

*Habitat*.—Solitary on sandy soil.

*Distribution*.—Auckland, N.Z. (Berggren. Type, in Herb. Kew), Mt. Lofty, S. Aus. (J. B. Cleland, 4/8/22. Specimens in Herb. Cleland).

This species is characterised by the small, smooth, depressed-globose peridium and long, slender, solid stipe. The lachrymiform spores are also characteristic.

The Mt. Lofty collection is undoubtedly the same as the species described by Massee, as it agrees in all characters, save in the size of the spores. The difference in spore measurement is too slight to allow of the separation of these specimens. The solid stipe is a character present only in this and the following species. In shape the plant shows a general resemblance to *S. erythrocephalum*, but the pallid colour of the peridium, and the verruculose spores separate it.

I am indebted to Dr. Cleland for the loan of the material from which the above description has been drawn up.

#### 10. SECOTIUM GUNNII Berkeley. (Text-fig. 12.)

Berk., in Herb.; Massee, Grevillea, vol. 19, 1890, p. 96; Sacc., Syll. Fung., vol. 11, 1895, p. 157; Cke., Hdbk. Aust. Fung., 1892, p. 221.

Peridium pallid brown, depressed-globose, base deeply excavated, truncate, 1.5 cm. diam., smooth; drying dingy-brown, rugulose.

Stipe short, 1-1.5 cm. long, 2-4 mm. thick, slender, equal, or slightly thickened downwards, solid, pallid-brown; columella expanded at the apex.

Gleba ferruginous, cellular, cells minutely polygonal, 1 mm. long, dissepiments thin.

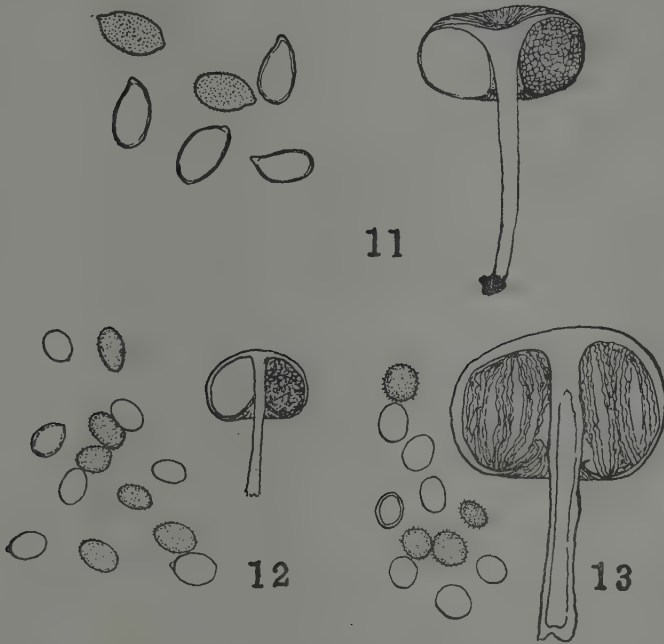
Spores minutely verruculose, broadly elliptical, pallid ferruginous, one end bluntly rounded, the other apiculate,  $6-8 \times 4-5 \mu$  (Massee,  $7 \times 4 \mu$ ), epispore thin.

*Habitat*.—Solitary on the ground.

*Distribution*.—Sulphur Springs, Rotorua, N.Z. (Gunn. Type in Herb. Kew), Hobart (L. Rodway, Jan. 1884. Specimens in Herb. Rodway).

The smooth peridium, short, solid stipe and small, rough spores characterise this species. It is separated from the preceding principally on account of the short stipe and the small size of the spores.

In the original description the spores are stated to be smooth, but I find them to be minutely but distinctly verruculose. This character varies somewhat in individual plants, for, of the two plants in my possession, one exhibits more pronounced markings than does the other.



Text-fig. 11. *S. leucocephalum* Mass. Plant (nat. size); spores ( $\times 1000$ ).

Text-fig. 12. *S. Gunnii* Berk. Plant (nat. size); spores ( $\times 1000$ ).

Text-fig. 13. *S. Guinzii* Kunze. Plant (nat. size); spores ( $\times 1000$ ).

Lloyd (1905) states that he believes this to be a synonym of *S. coarctatum*; but examination will show that both in glebal and spore characters it is decidedly different.

I am indebted to Mr. Rodway for the donation of two specimens of this species, now in my herbarium, No. 1203. The question may be raised as to whether the material I have examined is that of *S. Gunnii*, but I am assured by Mr. Rodway that these specimens are from a collection determined by Massee himself.

## 11. SECOTIUM PORPHYREUM, n.sp. (Pl. xv., fig. 2; Text-fig. 14b.)

Peridium violaceo, depresso-globoso, 7 cm. alto, 7 cm. lato, leve, glabro. Stipite pallido-violaceo, 3-9 cm. longo, 10-20 mm. crasso, fibrilloso, striato, excavato. Gleba pallido-brunnea, cellulosa vel labyrinthiforma. Sporidia grosse verruculosi, castaneo-brunnei, ovati, 12-17 x 8-11  $\mu$ .

Hab.: Solitarii ad terram in silvis.

York Bay, Wellington, N.Z. 30 m., E. H. Atkinson.

Peridium violet, depressed-globose, base truncate, deeply excavated, up to 7 cm. high, and 7 cm. broad, smooth, glabrous, polished, viscid; drying pallid-brown, becoming rugulose.

Stipe pallid-violet, tinted yellow at the base, stout, 3-9 cm. long, 10-20 mm. wide at the base, tapering to the apex, fibrillose, minutely striate, hollow; columella slightly expanded at the apex.

Gleba pallid ferruginous, labyrinthiform or cellular, cells 1-2 mm. long, numerous, dissepiments thick.

Spores coarsely verruculose, chestnut-brown, ovate, one end rounded, the other pointed, 12-17 x 8-11  $\mu$ , epispore thin.

Habitat.—Solitary on the ground in beech forest. (*Nothofagus* sp.).

Distribution.—Beech Forest, York Bay, Wellington, N.Z. (E. H. Atkinson, 30 m., 5/10/10. Type, May, Aug., 1922; E. J. Butler, G.H.C., 29/7/23), Dun Mt., Nelson (J. C. Neill, 30/5/23). Collections in the herbarium of the writer. Nos. 873, 923, 1208.

This species is characterised by the large size and violet colour of the peridium. It is not uncommon in a certain beech forest near Wellington, appearing there during the winter months, usually after heavy rain. At first it is buried in the ground, often in clayey soil, but as it approaches maturity it appears on the surface. When submerged it is a pallid white, but as soon as it is exposed to the light it changes colour; that this change is effected by light is obvious when a specimen that has partially emerged is examined, for it is then seen that the portion above the ground is violet, but that the remainder is white. The peridium is decidedly viscid when fresh.

In its younger stages the plant is readily confused with *Gallacea scleroderma* (Cke.) Lloyd, as in colour and hypogaeal habit it resembles this species; but when the peridium is sectioned the plants may be readily separated.

## 12. SECOTIUM GUINZII Kunze. (Text-fig. 13.)

Kunze, Flora, p. 322, 1840; Berk., Hook. Jour. Bot., vol. 2, 1843, p. 200; Sacc., Syll. Fung., vol. 7, 1888, p. 52; Cda., Icon. Fung., vol. 6, 1854, t. vi., f. 10-18.

Peridium depressed-globose or ovate, base excavated, up to 5 cm. diam., ochraceous, glabrous; drying ochraceous, becoming rugulose.

Stipe 3-5 cm. long, 8-12 mm. wide, equal, ochraceous, dull, pruinose.

Gleba ferruginous, lamellate, of closely compacted vertical plates, held together by interwoven hyphae.

Spores verruculose, subglobose, tinted yellow, 5-7  $\mu$  diam.

Habitat.—Solitary on the ground.

Distribution.—Cape of Good Hope, Tasmania (L. Rodway, Feb., 1923. Specimens in Herb. Rodway).

The above description is drawn up from a specimen kindly forwarded by Mr. Rodway, now in my herbarium, No. 1204. The species was determined for



Mr. Rodway by Mr. Lloyd. The above description does not agree well with that given by Saccardo, differing in the size and colour of the peridium, absence of "volva" from the base of the stipe, and colour and shape of the spores.

The peculiar nature of the gleba should characterise the Tasmanian plant; this consists of closely compacted plates arranged in a vertical manner around the columella, the whole apparently held compactly together by hyphae which pass from one plate to the other. Spores are not numerous—an unusual feature for a *Secotium*. I believe that the specimen at hand is parasitised by some Hyphomycete, for hyphae differing from the normal are abundant throughout the glebal tissues.

13. *SECOTIUM PIRIFORME* Cleland and Cunningham, n.sp. (Pl. xv., fig. 3; Text-fig. 15a.)

Peridio pallido-lilacino, depresso-globoso, vel piriformo, 12-16 mm. alto, 8-10 mm. lato, leve, glabro. Stipite griseo-albo, 5 mm. longo, 2-3 mm. crasso, leve, excavato. Gleba castaneo-brunnea, labyrinthiforma. Sporis grosse verruculosi, castaneo-brunneis, ellipticis vel liminiformis, apicibus acutis, 11-17 x 6-8  $\mu$ .

Hab.: Solitarii ad terram.

Somersby Falls, Gosford, N.S.W., G. P. Darnell-Smith.

Peridium pallid-lilac, depressed-globose, or commonly pyriform, 12-16 mm. high, 8-10 mm. wide, smooth, glabrous, polished, slightly viscid, attenuate downwards, margin continuous with the stipe; drying bay-brown, becoming rugulose.

Stipe pallid dingy-white, short, stout, 5 mm. long, 2-3 mm. wide, smooth, glabrous, hollow (or solid?), attenuate downwards, base somewhat inflated.

Gleba chestnut-brown, labyrinthiform, cells minute, irregular, up to 1 mm. long, numerous, dissepiments thin.

Spores coarsely verruculose, chestnut-brown, elliptical or commonly lemon-shaped, pointed at both ends, frequently pedicellate, 11-17 x 6-8  $\mu$ , epispore thin.

Habitat.—Solitary on sandy soil in damp places.

Distribution.—Somersby Falls, Gosford, N.S.W. (G. P. Darnell-Smith, 4/7/15, 27/6/16. Specimens in Herb. Cleland).

A further collection, obviously of the same species, but preserved in formalin, was forwarded by Dr. Cleland. This agrees with the above description, save that the spores are slightly larger.

When dried this species is about the size of a garden pea; it differs from all other Australasian species in that it possesses a "sterile base." This is in reality the base of the stipe to which the margin and base of the peridium are adherent, for in one specimen partial rupture may be observed (under the microscope) especially between the gleba and the stipe. I believe the specimens to be immature.

This species is characterised by the colour and small size of the peridium, together with its shape, and the glebal characters.

I am indebted to Dr. Cleland for the loan of the type material.

14. *SECOTIUM CARTILAGINEUS*, n.sp. (Pl. xviii., fig. 4; Text-fig. 15b.)

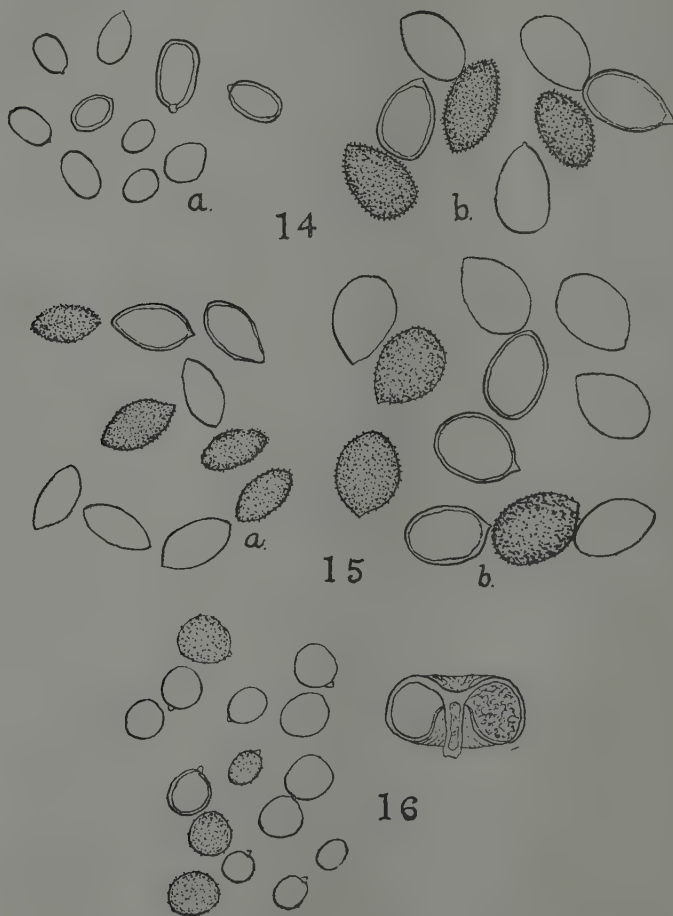
Peridio pallido-brunneo, depresso-globoso, base excavato, 7-12 mm. alto, 18-22 mm. lato, scabrido. Stipite 10 mm. longo, 4 mm. crasso, brunneo, excavato. Gleba aurantio-brunnea, cellulosa, lenta. Sporis verruculosi, flavo-brunneis, ovatis, 12-15 x 8-11  $\mu$ .

Hab.: Solitarii ad terram in silvis.

Dun Mt., Nelson, N.Z., 650 m., J. C. Neill.

Peridium pallid-tan, paler below, depressed-globose, base excavated, incurved, margin distinct from stipe, 7-12 mm. high, 18-22 mm. wide, densely and closely scabrid; drying dingy-brown.

Stipe short, stout, up to 10 mm. long, 4 mm. thick, tan-coloured, hollow, scabrous, base slightly inflated.



Text-fig. 14. a. Spores of *S. melanosporum* Berk. ( $\times 1000$ ); b. Spores of *S. porphyreum* G. H. Cunn. ( $\times 1000$ ).

Text-fig. 15. a. Spores of *S. piriforme* Clel. et Cunn. ( $\times 1000$ ); b. spores of *S. cartilagineus* G. H. Cunn. ( $\times 1000$ ).

Text-fig. 16. *S. Rodwayi* Mass. Plant (nat. size); spores ( $\times 1000$ ).

Gleba dark ferruginous, cellular, tough, compact, cells minute, 2-3 mm long, polygonal, dissepiments thin.

Spores verruculose, ferruginous, ovate, rounded at one end, pointed at the other, 12-15 x 8-11  $\mu$ , epispore thin.

*Habitat*.—Solitary on the ground in beech forest.

*Distribution*.—Beech Forest, Dun Mt., Nelson, N.Z., 650 m. (J. C. Neill), 27/5/23. Type in herbarium of the writer, No. 1099).

The scabrid surface of the peridium would place this close to *S. scabrosum*, but the glebal characters are different from those given for the latter species.

In appearance and to the touch the peridium exactly resembles chamois leather. The tough, almost cartilaginous nature of the gleba is also characteristic, and would serve to separate it from any other Australasian species.

#### 15. *SECOTIUM RODWAYI* Massee. (Text-fig. 16.)

Mass., Kew Bulletin, 1901, p. 158; Sacc., Syll. Fung., vol. 17, 1901, p. 218.

Peridium ochraceous-white, depressed-globose, umbilicate, base deeply excavated, 2-3 cm. diam., tomentose; drying dingy-brown, becoming rugulose.

Stipe hardly apparent, 3 x 2 mm., subequal, hollow, tomentose.

Gleba pallid-ochraceous, labyrinthiform, cells minute, 1 mm. long, dissepiments thin.

Spores verruculose, hyaline, globose or subglobose, apiculate, 6-9  $\mu$  (Massee, 7-8  $\mu$ ), epispore thin.

*Habitat*.—Hypogean, solitary in sandy soil.

*Distribution*.—Tasmania. (L. Rodway, June, 1898. Type, in Herb. Kew).

The small size, shape and colour of the spores separate this from any other species possessing a rough peridium. Massee states that the species is subterranean, and specimens are exposed only when washed out by rain or dug out by small marsupials.

I am indebted to Mr. Rodway for co-type material from which the above description has been drawn up. These are now in my herbarium, No. 1205.

#### 16. *SECOTIUM SCABROSUM* Cooke and Massee.

Cke. et Mass., Grev., vol. 20, 1891, p. 35; Cke., Hdbk. Aust. Fungi, 1892, p. 221; Sacc., Syll. Fung., vol. 11, 1895, p. 57.

Peridium dingy-olive, or greyish, depressed-globose, 2 cm. diam., minutely scabrid.

Stipe short, almost obsolete.

Gleba dark reddish-brown, lacunose, septa gill-like, warted and folded.

Spores rather coarsely warted, lemon-shaped, pallid olive-yellow, 16-18 x 10  $\mu$ .

*Habitat*.—Solitary on the ground.

*Distribution*.—Domain, Melbourne (Mueller. Type in Herb. Kew).

I have not seen specimens; the above description is that of the original.

The species should be readily determined on account of the lamellar gleba. Strangely enough, this is the only record of the occurrence of this genus in the State of Victoria.

#### EXCLUDED SPECIES.

##### a. *Secotium Drummondii* Berkeley, in *Herb*.

This has by Massee been used as the type of his genus *Chainoderma* Mass. (Grev., vol. 19, 1890, p. 46).



b. *Secotium excavatum* Kalchbrenner.

Hennings has placed this in the genus *Strobilomyces* (Boletinae) as *S. excavatum* P. Henn. (Hedw., vol. 43, 1904, p. 187).

c. *Secotium lilacense* Berkeley, Hdbk. N.Z. Flora, 1867, p. 617.

As the description of this species was drawn up from a water colour drawing, and not from a specimen, it has no place in botanical literature. The description given by Berkeley is such that if the plant should be encountered the finder would have some difficulty in determining it!

"Azure, brief, pallid, fibrose, pruinose; pileus subglobose, lilac, spotted, 12 mm. high.

Hab.: On wood, Central N.Z., Haast.

d. *Secotium sessile* Mass. et Rodw. *Nomen nudum*.

Dr. Butler, Bureau of Mycology, Kew, informs the writer \* that Mr. Mason of the Bureau has searched for but has been unable to find any published description of this plant. He states that there is a collection at Kew Herb., labelled "Tasmania, Rodway, 647, Type."

*Literature cited.*

- ATKINSON, G. F., 1906.—The Development of *Agaricus campestris*. *Bot. Gaz.*, vol. 42, pp. 215-221.  
 ———, 1914.—The Development of *Agaricus arvensis* and *A. comtulus*. *Amer. Journ. Bot.*, vol. 1, pp. 3-22.  
 ———, 1915.—Morphology and Development of *Agaricus Rodmani*. *Proc. Amer. Phil. Soc.*, vol. 54, pp. 309-342.  
 BERKELEY, J. B., 1843.—On Two Hymenomycetous Fungi belonging to the Lycoperdaceae Group. *Hook. Journ. Bot.*, vol. 2, p. 200.  
 CONARD, H. S., 1915.—The Structure and Development of *Secotium agaricoides*. *Mycologia*, vol. 7, pp. 51-60.  
 DE TONI, J. B., 1888.—Hymenogastraceae and Lycoperdaceae in Saccardo's *Sylloge Fungorum*, vol. 7, pp. 51-60.  
 FISCHER, Ed., 1900.—Untersuchungen zur Vergleichenden Entwicklungsgeschichte und Systematik der Phalloideen. *Denkschr. d. Schweiz. naturf. Ges.*, vol. 36, pp. 73-74.  
 ———, 1900a.—Hymenogastrineae. Engler & Prantl *Natürlichen Pflanzenfamilien*, I, pp. 296-313.  
 HENNINGS, P., 1900.—Hymenomycetineae. Engler & Prantl *Naturl. Pflanzenfam.* I, pp. 105-276.  
 LLOYD, C. G., 1905.—Lycoperdaceae of Australia, New Zealand and Neighbouring Islands, pp. 1-44.

## EXPLANATION OF PLATES XII.-XV.\*

## Plate xii.

1. Developmental stage of *S. novae-zelandiae* G. H. Cunn. (x 45). First appearance of radial cavity in primordium of the gleba. Note parallel arrangement of the hyphae of the stipe. The striae across the surface are caused by gaps in the microtome knife.

2. Later stage; the wedge-shaped area of the partial veil has become well defined. (x 35).

\*Letter to writer, 25/10/23.

3. Stage showing first appearance of the cavity of the stipe, and down-growth of tramal plates from the roof of the first glebal cavity. Note the abundant spores, well-marked partial veil and parallel arrangement of the hyphae of the stipe. (x 25).

4. Appearance of lacunae in the undifferentiated portion of the gleba (top, left). (x 15).

5. Further differentiation of the gleba. (x 8).

Plate xiii.

1. Stage showing the appearance of lacunae in the tramal plates in *S. novae-zelandiae*. (x 8).

2. *S. erythrocephalum* Tul. (nat. size).

3. *S. novae-zelandiae* G. H. Cunn. (nat. size). Section on left. Photograph from water colour painting by E. H. Atkinson.

Plate xiv.

1. Section through nearly mature plant of *S. erythrocephalum* Tul. (not quite median). (x 4). *p.*, peridium; *gl.*, gleba; *col.*, columella; *st.*, stipe. The perforations in the columella are due to insects.

2. *S. superbum* G. H. Cunn. (x  $\frac{1}{2}$ ).

Plate xv.

1. *S. melanosporum* Berk. (nat. size). Note coarsely cellular stipe.

2. *S. porphyreum* G. H. Cunn. (Nat. size). Note that although the gleba is removed from the stipe it is nevertheless covered with remnants of the partial veil.

3. *S. piriforme* Clel. et Cunn. (nat. size). (Formalin specimens photographed in solution of formalin).

4. *S. cartilagineus* G. H. Cunn. (nat size).

*Corrigenda.*

Page 104, line 7 from bottom *for* locis gramineis *read* sylvis

Page 105, line 7 *delete* in grassy places; lines 9, 10 *read* Forest Reserve, Packakariki, Whakatikei

Page 108, line 8 from bottom, and page 110, line 10, *for* Cleland *read* Cleland and Cheel

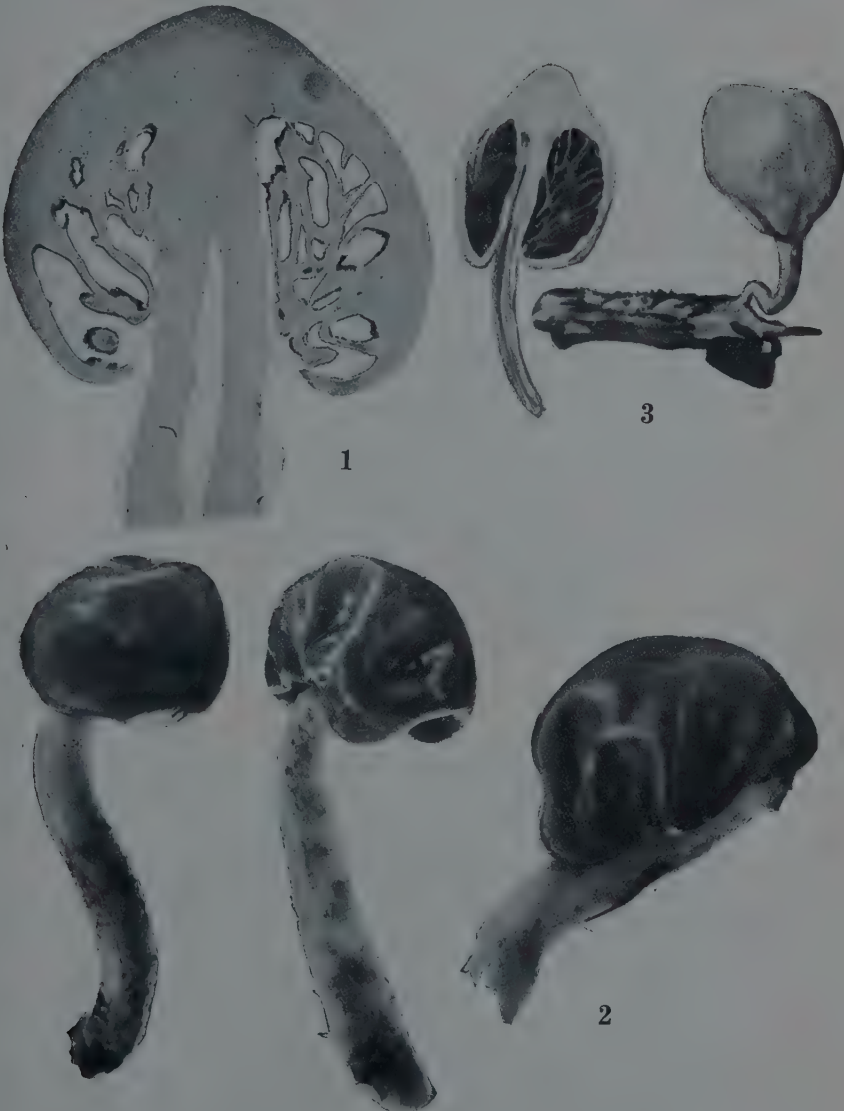






*Secotium novae-zelandiae*.





1, 3. *Secotium norae-selandiae*.      2. *S. erythrocephalum*.







1. *Secotium erythrocephalum*.



2. *Secotium superbum*.





1. *Secotium melanosporum*.  
3. *S. piriforme*.

2. *S. porphyreum*.  
4. *S. cartilagineus*.







